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A STANDARD TREATISE ON PHYSICS.

Traité de Physique. By O. D. Chwolson. Translated from the Russian and German editions by E. Davaux. Second volume, fourth fascicule. Pp. 641–1188. Third volume, first fascicule. Pp. vii + 408. Fourth volume, first fascicule. Pp. vii + 430. Figures in text. (Paris: Hermann et Fils, 1909.) Price 17, 13 and 12 francs respectively.

SINCE this is a French translation of a work which has already been reviewed in part as a German translation (from the Russian), we will not do more than examine those parts in which it differs from its previous forms or which have not previously been reviewed here. It is by no means a mere translation. Extensive additions have been made under Prof. Chwolson's supervision with the object of maintaining the book level with the rapid advances in physics that have taken place. These have been made with the author's usual discriminative ability. If there is one quality more than another which strikes us about this text-book it is the rare combination of knowledge and good judgment which everywhere characterises it. Other volumes which we know may be more encyclopædic. If our object is to find out *all* that has been done on any special subject we may be disappointed if we turn up the subject here. But if our object is to find a judicious selection of the best that has been thought and written on physical questions, then we know of no better source from which our object can be attained. In other words, this is a text-book of a preeminent order, written by one who has a unique command over all branches of physical science, and who is as alive to the most recent developments as to those portions which have now become classical.

Of the additions to the fourth fascicule, which deals with diffraction, double refraction, and polarisation of light, we may point out the account of recent work by Dufet on the remarkable anomalous dispersion of the optic axes in the case of the sulphates of neodymium and praseodymium which is exhibited in the region of optical absorption. Several additional pages are devoted to an account of the optical properties of liquid crystals as studied by Lehmann and others. Two lengthy paragraphs are added by the translator dealing with the reflection and refraction of polarised light according to Green, and with the gyrostatic theory of light. These paragraphs certainly supplement the rest of the chapter into which they are inserted, and, as many readers will be glad to have them, no exception can be taken in regard to their insertion. But it may be intimated that they are considerably more mathematical than the greater part of the book, and they therefore do not harmonise very well with the rest.

We are certainly surprised to find that what is essentially a distinct treatise is bound up with this fascicule, and constitutes the end of the second volume. This consists of a note on the theory of deformable bodies, by MM. E. and F. Cosserat. This note is 220 pages long, and it does not in any sense harmonise with the work with which it is incorporated. Prof. Chwolson's work is emphatically experimental in character; the note is as strikingly mathematical. We do not wish in the slightest degree to discredit either the matter or the manner of the note taken by itself. But there does not seem to be any justification for loading a text-book which is necessarily very bulky by matter which will probably never be consulted at the same time as the body of the book itself. The MM. Cosserat's note is a distinct and useful treatise, and should be quite able to stand on its own feet.

The changes in the first fascicule of the third volume are not so considerable. This part deals with thermometry, specific heats, thermochemistry, and thermal conductivity. So far as we can find, there is only one additional section, which treats in a general way of the problem of Fourier, and gives a short account of the allied researches of M. Poincaré. This is a very useful addition.

The first part of the fourth volume has not yet been reviewed in these columns, and it deserves a more extended notice. Its subject-matter is the stationary electric field. The introduction to this part is specially noteworthy. It has seemed to Prof. Chwolson necessary to commence by giving a summary of the singular and exceptional situation in which the science of electrical and magnetic phenomena now is. At the present time one may distinguish no fewer than three various points of view from which these subjects are regarded. We have, in the first place, to deal with the *external structure* of a very great number of different phenomena which, perceived by our senses, awaken in us a representation more or less definite of what is proceeding, or, more exactly, of what seems to us to proceed in a given direction and under given conditions. Thence arises a description of phenomena and of the laws and rules by which those phenomena are regulated. Secondly, we may place ourselves at another point of view, and consider the practical applications; or, thirdly, we may endeavour to *explain* these phenomena by showing that they are the necessary consequence of the existence of a certain substratum to which the laws of mechanics and thermodynamics are applicable. In regard to this third point of view, Prof. Chwolson declares that—

"Without wishing to exaggerate, we may say, after having glanced rapidly over the facts, that there does not exist at this moment in the part of this science which has for its object the *explanation* of phenomena, any theory which is firmly established upon which we may rely in a manner free from all possible doubt to give an account of *all* phenomena."

He recognises, however, three fundamental conceptions which excite three distinct images or pictures which give a more or less exact representation of the intimate cause of phenomena. These he designates by the letters A, B, and C. The image A, adopted in a general manner up to the year 1870, was constructed on the notion of two electricities, enjoying the property of acting instantaneously at a distance.

Though retained in elementary expositions, serious science has abandoned it for ever.

The image B (1870 to 1890) left entirely on one side the conception of a special electrical substance, and sought to explain electrical phenomena by the properties of the æther alone. But although this picture enabled one to form a representation of radiant electrical energy, it, too, has been found insufficient to explain a great number of phenomena.

The image C is based on the notion of *electrons*, and forms, to some extent, a combination of A and B. It supposes the existence of a special substratum, and preserves the idea of modifications produced in the body of the æther; but the electrical substance is now considered as the origin of these modifications in the æther.

We have summarised these distinctions because they characterise the entire fascicule. Prof. Chwolson adheres to these distinctions throughout, and the result is that he is able to produce a final picture which is more free from confusion than if he had attempted to remove the dividing lines between them. Again, the student will leave his perusal of these pages with a far wider conception of the general lie of the land than if one or other of these points of view had been purposely blocked out. We do not wish to disparage any recent books which emphasise one of these pictures to the practical exclusion of others. They serve their purpose. The pioneer is necessarily preoccupied with his own line of march. But there is a danger that, in the enthusiasm created by recent discoveries and the success attending the contemplation of picture C, the rest of the landscape will be forgotten. We can wish for no better training for a student than a perusal of Prof. Chwolson's treatise.

Of the general character of the book in its French form we may say that we do not like it quite so well as the German. The illustrations, which are taken from the German translation, do not show up as satisfactorily on the paper selected. But the production of a French translation will be welcomed by many to whom German is not intelligible; and it may be said without any hesitation that, in the form in which it now appears, we have a text-book of physics which is second to none in the French language. It should be in the library of every physical laboratory, and students who are taking up the subject of physics seriously will find it one of the best text-books of which to obtain private possession.

FLOWER POLLINATION.

Handbook of Flower Pollination. By Dr. P. Knuth. Based upon Hermann Müller's work, "The Fertilisation of Flowers by Insects." Translated by Prof. J. R. Ainsworth Davis. Vol. iii. (Band ii., Teil ii., of the German edition), Observations on Flower Pollination made in Europe and the Arctic Regions on Species belonging to the Natural Orders. Goodenovieæ to Cycadeæ. Pp. iv+644. (Oxford: Clarendon Press, 1909.) Price 28*s.* net.

VOL. III. of the English translation, which has now appeared, concludes that portion of Knuth's handbook for which that author was himself responsible. The later volumes, issued after Knuth's death by Dr. E. Loew, deal with observations on flower pollination made beyond the confines of Europe, while the earlier volumes contain the observations made in Europe and the Arctic regions, vol. iii. dealing with species belonging to the orders Goodenovieæ to Cycadaceæ.

The English translation, appearing, as it does, ten years after the publication of the original German edition, has been brought up to date in many respects. The arrangement of the Natural Orders has been altered in consonance with more recent classification, and some Orders have been merged as Sub-orders in the larger Families. In many instances new observations have been added, and additional literature is referred to, as, for instance, in the case of the primrose, the pollination of which has been much disputed, and also in the case of Pentstemon, of which genus Loew has latterly made a very considerable study.

This volume, like its predecessor, must be regarded as a most valuable book of reference, yet here and there are points of more general interest to which, perhaps, reference should be made. On p. 434, when dealing with the flower of the snowflake (Leucojum), Knuth gives an interesting summary of the method he has adopted to detect the presence of a nectary, when the position of that organ is not obvious at first sight. By suitable treatment of flowers with Fehling's solution or Hoppe-Seyler's sugar reagent he was able to detect the nectar-secreting part of most flowers. Sometimes even fairly conspicuous flowers, as, for instance, those of *Pyrola uniflora*, were found to be nectarless, and in this case, though the flower is otherwise obviously adapted to insect pollination, no insect visitors are recorded in the handbook. Indeed, this volume, like the preceding one, would yield much valuable information to anyone in search of opportunities of enriching botanical science by accurate observations in the field, for a number of plants, some of them quite common, still require their insect visitors to be recorded.

Some of the orders, like the Ericaceæ, are of interest, because in some genera, *e.g.* Calluna, Erica, and Cyclamen, the flowers, though adapted to insect pollination, and very eagerly visited by insects, are during their later stages anemophilous, the pollen becoming dry and powdery, and being readily carried by wind. On the other hand, some flowers normally adapted to wind pollination, like the sweet chestnut (Castanea), also attract insects, and are no doubt pollinated by them.

The translator has omitted to note the observations made recently on the dog's mercury (Mercurialis), which indicate that this plant is provided both with nectaries and sticky pollen, so that though apparently anemophilous, and probably at times wind pollinated, it is adapted to the visits of insects, and, as Knuth records, is often visited by them.

The anemophilous Gramineæ, too, offer many points of interest in connection with the frequent occurrence of cleistogamy and self-pollination of their flowers. Insect visits are occasionally observed in this group. Ludwig considered that the succulent shining lodicules of many grasses sometimes